

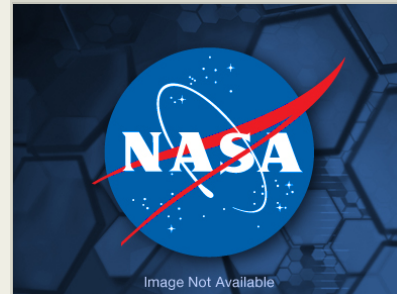
A Stable, Non-Cesium III-Nitride Photocathode for Ultraviolet Astronomy Applications

Completed Technology Project (2016 - 2019)



Project Introduction

In this effort, we propose to develop a new type of cesium-free photocathode using III-nitride (III-N) materials (GaN, AlN, and their alloys) and to achieve highly efficient, solar blind, and stable UV response. Currently, detectors used in UV instruments utilize a photocathode to convert UV photons into electrons that are subsequently detected by microchannel plate or CCD. The performance of these detectors critically depends on the efficiency and stability of their photocathodes. In particular, photocathode instability is responsible for many of the fabrication difficulties commonly experienced with this class of detectors. In recent years, III-N (in particular GaN) photocathodes have been demonstrated with very high QE (>50%) in parts of UV spectral range. Moreover, due to the wide bandgaps of III-nitride materials, photocathode response can be tailored to be intrinsically solar-blind. However, these photocathodes still rely on cesiation for activation, necessitating all-vacuum fabrication and sealed-tube operation. The proposed photocathode structure will achieve activation through methods for band structure engineering such as delta-doping and polarization field engineering. Compared to the current state-of-the-art in flight-ready microchannel plate sealed tubes, photocathodes based on III-N materials will yield high QE and significantly enhance both fabrication yield and reliability, since they do not require cesium or other highly reactive materials for activation. This performance will enable a ~4 meter medium class UV spectroscopic and imaging mission that is of high scientific priority for NASA. This work will build on the success of our previous APRA-funded effort. In that work, we demonstrated III-nitride photocathode operation without the use of cesium and stable response with respect to time. These accomplishments represent major improvements to the state-of-the-art for photocathode technologies. In the proposed effort, we will implement III-nitride polarity control, polarization charge engineering, and alloy fraction control to demonstrate a high-QE, solar-blind photocathode with air-stable UV response. Through our design, growth, and processing techniques, we will extend the application of these photocathodes into far UV for both semitransparent and opaque mode.



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

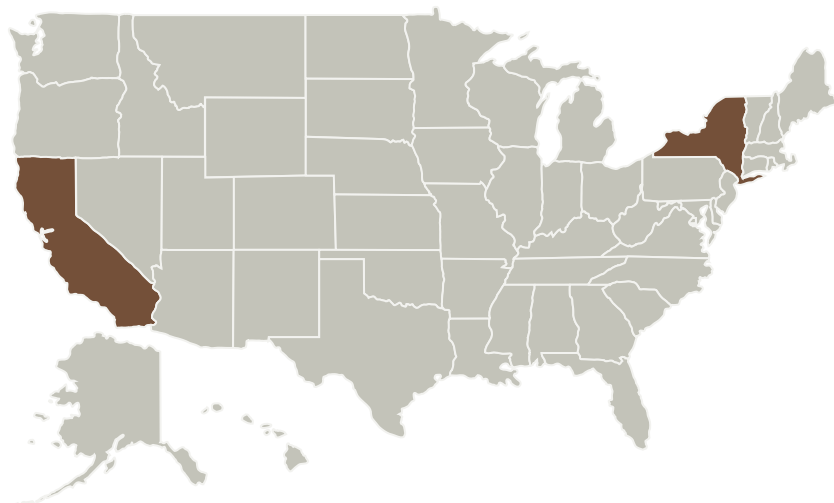
Astrophysics Research and Analysis

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology (CalTech)	Supporting Organization	Academia	Pasadena, California

Primary U.S. Work Locations	
California	New York

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Lloyd D Bell

Co-Investigators:

Fatemeh Shahedipour-sandvik

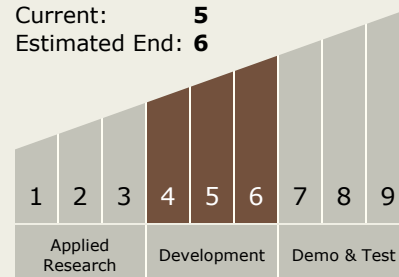
Karen R Piggee

Shouleh Nikzad

Christopher Martin

Technology Maturity (TRL)

Start: 4
Current: 5
Estimated End: 6



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.1 Remote Sensing Instruments/Sensors
 - TX08.1.1 Detectors and Focal Planes

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Target Destination

Outside the Solar System